UNITED STATES FISH AND WILDLIFE SERVICE

Imperial National Wildlife Refuge

A Report on Wilderness Character Monitoring

Molly McCarter

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This document was created as part of the FWS National Wildlife Refuge System Wilderness Character Monitoring Program of 2011. This pilot program is part of a national strategy for wilderness inventory and monitoring. Accompanying this report is a Wilderness Character Monitoring Database program with entries specific to this refuge.

"Thousands of tired, nerve-shaken, over-civilized people are beginning to find out that going to the mountains is going home; that wildness is a necessity; that mountain parks and reservations are useful not only as fountains of timber and irrigating rivers, but as fountains of life."
- John Muir

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SETTING OF THE REFUGE WILDERNESS

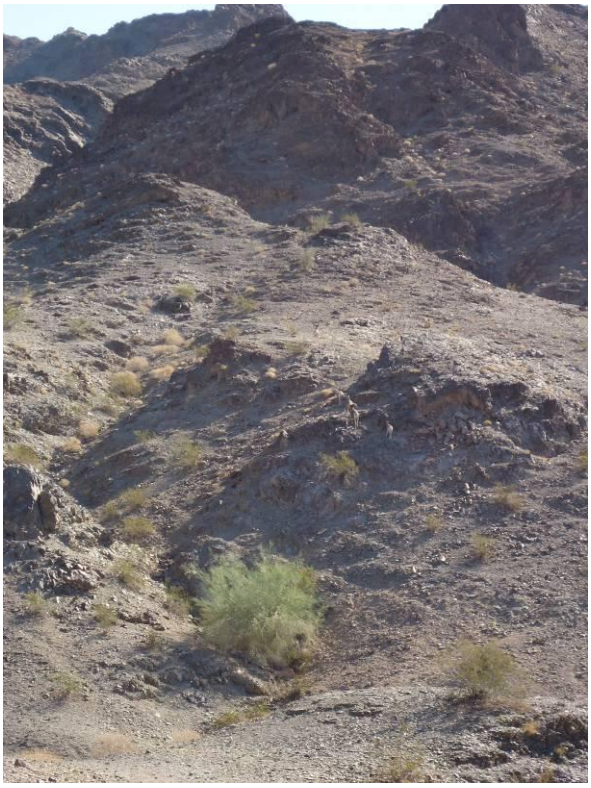
Geographic setting

The Imperial National Wildlife Refuge is 25,125 acres on 30 miles of the west and east sides of the Lower Colorado River. Of this, 15,056 acres (9,220 acres in Arizona and 5,836 acres in California) is designated wilderness. The Imperial Refuge Wilderness includes the counties of Yuma (AZ), La Paz (AZ), and Imperial (CA). It is bordered by the Indian Pass Wilderness to the west, the Little Picacho Wilderness to the south, and the Trigo Mountain Wilderness to the east. On both the Arizona and California sides of the Imperial Refuge Wilderness, the wilderness boundary adjacent to the Colorado River begins at the 200/220 feet elevation contour and does not reach or include any portions of the Colorado River. This leaves a small buffer around the Colorado River that is refuge but not wilderness. The wilderness then extends from this Colorado River boundary to the refuge boundary.

Ecological setting

The Fish and Wildlife Service identified and mapped 53 ecosystem units throughout the United States by grouping watersheds. Ecosystem Teams were established and directed to develop plans for each unit that describe ecological resources, issues relevant to the resources, and conservation strategies. The Imperial National Wildlife Refuge is part of the Lower Colorado River Ecosystem, one of the nine ecosystem units within the Southwest Region.

The Imperial Refuge Wilderness is comprised of Sonoran Desert upland habitats including mountainous terrain reaching 3,200 feet in elevation and several desert washes. The uplands are a sparsely vegetated combination of sandy washes, scattered highly-eroded hills, and low, boulder-strewn mountain slopes. The dominant plant type association in desert uplands is creosote bush-white bursage. Other plant species include numerous ephemerals, eight species of cacti, and ocotillo. Tree species found

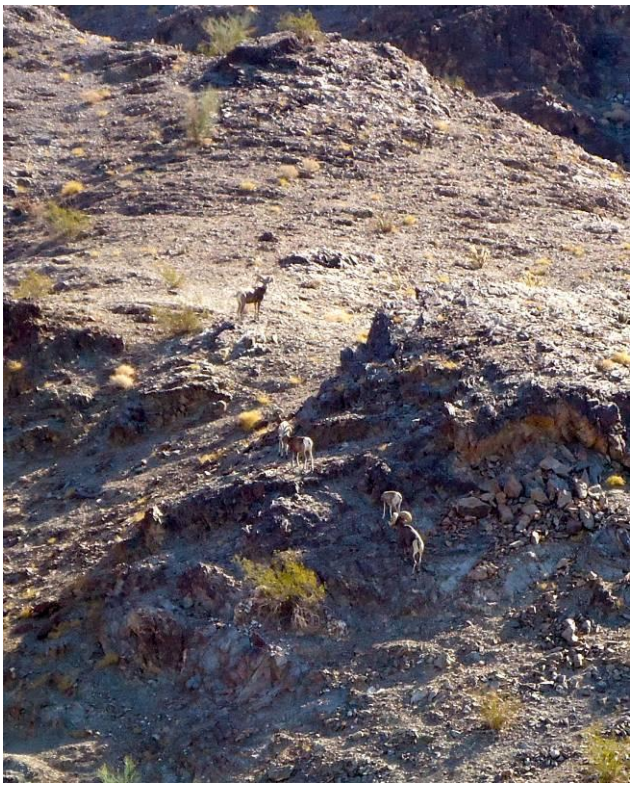


Imperial Refuge Wilderness Uplands, Molly McCarter (2011).

in the washes are microphyllous and include honey mesquite, ironwood, palo verde, and smoketree. Understory plants in the washes include cat claw acacia, burrobrush, desert broom, desert willow, chuparosa, and desert honeysuckle.

The Imperial Refuge Wilderness includes avian, mammalian, and reptilian habitats. Desert washes provide important nesting and wintering habitat for several passerine species, such as the Gila woodpecker and brown-crested flycatcher. Raptors, including the peregrine falcon and great-horned owl, also utilize the habitats found in the Imperial Refuge Wilderness. Coyote, bobcat, the kit fox, and several sensitive bat species are among the small mammals present in the wilderness. Species of concern residing in the Imperial Refuge Wilderness include the Sonoran desert tortoise, chuckwalla, and Gila monster.

The climate of the Imperial Refuge Wilderness is typical of desert areas, being one of the hottest and driest regions in North America. The precipitation can range from 2-8 inches/year (average is 3 inches) and periods of prolonged drought may occur throughout the year. Summer rains are characterized by isolated, intense thunderstorms. Summers are long with normal daily temperatures over 100° Fahrenheit and can reach up to 122-124° Fahrenheit. Winters are mild with temperatures from freezing to the mid-80's.



Imperial Refuge Wilderness uplands with bighorn sheep, Molly McCarter (2011).

Imperial Refuge Wilderness uplands with bighorn sheep, Molly McCarter (2011).

History of establishing the wilderness

The Imperial National Wildlife Refuge was established in 1941 by Executive Order 8685 to preserve all forms of life found in the lower Colorado River region. The Arizona portion of the Imperial Refuge Wilderness was designated in 1990 by the Arizona Desert Wilderness Act of 1990 (Public law 101-628). The California portion of the Imperial Refuge Wilderness was designated in 1994 by the California Desert Protection Act of 1994 (Public Law 103-433). Both acts designated many different public lands in these states as separate wildernesses. Historically this stretch of river was the home to the Yuma or Quechan Indians. The California gold rush of 1849 and the Gadsden Purchase (1853) paved the way for exploration and settlement. Present refuge lands were important mining areas in the 19th Century. The construction of the Laguna Dam in 1909 ushered in the era of river control and agricultural development of the Lower Colorado Valley.

Refuge purposes

The Imperial National Wildlife Refuge was established February 14, 1941 by Executive Order 8685 as "…a refuge and breeding ground for migratory birds and other wildlife" and is "to provide migration and wintering habitat for migratory birds."

Flowering beavertail cactus, FWS

DOCUMENTS CONSULTED

- Lower Colorado River National Wildlife Refuges Comprehensive Management Plan (1994-2014). US Fish and Wildlife Service & US Bureau of Reclamation. 1994. Print.
- Trigo Mountains - Imperial National Wildlife Refuge Cooperative Management Plan (Draft). Bureau of Land Management & US Fish and Wildlife Service. March 2002. Print.
- Imperial Refuge Files Including:
  - Cultural Resources File 31.30
  - Wilderness Files 40.50-40.56
  - ORP Narratives (1998-2003), File 50.01 (disc)
  - Biologist Narratives (2000-2002), File 50.01 (disc)
- Imperial National Wildlife Refuge Arizona and California: Wilderness Proposal. US Fish and Wildlife Service. March 14, 1903. Print.
- Minimum Requirements Decision Guide Worksheets: Chain link fence removal - Imperial National Wildlife Refuge. Print.
- Keeping It Wild: An Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System, US Department of Agriculture. July 2008. Print.
- Arizona Desert Wilderness Act of 1990 (Public law 101-628).
- California Desert Protection Act of 1994 (Public Law 103-433).
- Annual Narratives (particularly those after wilderness designation) Including Years: 1986, 1991, 1993, 1994, 1995, 2003, 2004. Print.

STAFF CONSULTED

- Joseph Barnett, Refuge Biologist
- Denise Bausch, Visitor Services Manager
- Drew Cyprian, Law Enforcement Officer
- Elaine Johnson, Complex Manager/Refuge Manager
- Benjamin Stewart, Fire Operations Specialist
- Brenda Zaun, Zone Biologist

PROCESS USED FOR IDENTIFYING MEASURES

I began my time at the Imperial National Wildlife Refuge with reading wilderness-relevant refuge documents (see list above) and visiting the wilderness with the refuge manager and biologist. This gave me an adequate introduction to the wilderness and its character which allowed me to begin a running list of possible measures.

After I had an idea of what might be appropriate items to monitor, I had meetings with the refuge manager and biologist (separately) to discuss my list of possible measures and sources of baseline data. I was able to refine the list of measures after these meetings according to how practical each measure was and the availability and acquirement of data for each measure.

To orient other refuge staff with my assignment I gave a wilderness character monitoring presentation to all refuge personnel (including the fire team, maintenance team, law enforcement team, administration team, and biologists) which included examples from the Imperial Refuge Wilderness.

Once I felt that the refuge personnel were adequately informed about wilderness character monitoring, I scheduled meetings with appropriate refuge staff to discuss specific measures based on each staff's expertise. These meetings allowed me to further refine measure definitions and provided me with baseline data. Measures were added or eliminated based on data availability, reliability, and reasonableness.

Coots wintering in the Colorado River adjacent to the Imperial National Wildlife Refuge, Molly McCarter (2011)

MEASURES USED

This section provides information on the measures selected for the Imperial wilderness character monitoring protocol. This section provides information on the context of the measure within the Imperial Wilderness, data sources, and data quality. Also included is an assignment of the relevance of the measure within the indicator (high, medium, or low) which was derived from importance assignments from priority ranking sheets and the weight of the measures within the database, both of which were determined by refuge management. Information on data condition (for 2011), data confidence, and trend are represented by colored circles. The trend for all measures is stable (horizontal arrow) for the 2011 year because this is the baseline year. The condition is represented by the color of the circle: red (poor), yellow (caution), or green (good). The confidence in the data accuracy is represented by the line around the circle: a thick solid line (high confidence), thin solid line (medium confidence), or a dashed line (low confidence). This section does not provide any physical data; please refer to the Wilderness Character Monitoring Database for this data.

Desert spiny lizard at Imperial National Wildlife Refuge, FWS.

Quality: Untrammeled
Indicator: Actions authorized by the federal land manager that manipulate the biophysical environment
Measure: Percent of naturally started fires that received a suppression response.

♦ Context: If a wildfire occurs in wilderness, it is highly likely that it will be suppressed to prevent it from spreading to adjacent lands which include Yuma Proving Grounds, Bureau of Land Management land, recreational areas, wildlife refuge land, other wildernesses, and additional public and private lands.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data	Significant Change[1]	Confidence in Data Quality[2]
High	Imperial NWR Fire Crew	Inquiry to the fire operations specialist	Any	High
[1]Significant Change: (how it was determined)	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it. So few wildfires occur on the Imperial Refuge Wilderness that it was considered a significant change if even one more/less fire was suppressed in the wilderness.			
[2]Data Adequacy:	There is high confidence in the quality of this data because this is easily monitored and the fire management team keeps records on this data.			

Quality: Untrammeled
Indicator: Actions authorized by the federal land manager that manipulate the biophysical environment
Measure: Number of burros that are captured and removed from wilderness (burro "gathers").

♦ Context: The FWS in coordination with the Bureau of Land Management conducts "burro gathers" (removal of burros) whenever funding is available. Burros were introduced to the area by miners who abandoned them. Because of the destructive nature of these burros (who graze heavily on native plants, disturb fragile desert pavement, and damage cultural resource sites) they are removed from the refuge. An increase in this measure would show a degrading trend, but removing these animals from the wilderness would likely enhance the natural quality of the wilderness. Nonetheless, burro gathering is an obvious trammeling of animal species, thus affecting the "community of life" within the wilderness. This degrading trend would likely be offset by the measure "Average percentage of vegetation utilized by burros in washes that include wilderness" because as more burros that are removed from wilderness the damage to native vegetation should decrease. The Wild Horse and Burro Act dictates much of what can be done with these animals.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data	Significant Change[1]	Confidence in Data Quality[2]
Medium	Refuge biologist, zone biologist	Inquiry to the refuge biologist	Any	High
[1]Significant Change: (how it was determined)	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it.			
[2]Data Adequacy:	There is high confidence in the quality of this data because this is easily monitored and the biologists keep records on this data.			

Burro on Wildlife

the Imperial National Refuge, FWS.

Quality: Untrammeled
Indicator: Actions authorized by the federal land manager that manipulate the biophysical environment
Measure: Number of actions to trammel species in wilderness (including actions for surveys or research).

♦ Context: This measure is included to capture any additional trammeling in wilderness that is not encompassed by the previous measures. This measure would include monitoring of mist netting, snaring, and pesticide use in wilderness, which are all possible trammeling that could occur in the future; bat mist netting and pesticide use occurs on the Imperial NWR and mountain lion snaring occurs on the neighboring Kofa Refuge Wilderness.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data	Significant Change[1]	Confidence in Data Quality[2]
High	Refuge biologist, zone biologist	Inquiries to the refuge biologist, zone biologist, and Arizona Game and Fish Department	Any	High

[1]**Significant Change: (how it was determined)**	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it.
[2]**Data Adequacy:**	There is high confidence in the quality of this data because biologists keep records on all management actions which trammel species.

Example of species trammeling (use of mist nets for bat surveys) on Kofa Refuge Wilderness, Molly McCarter (2011).

Quality: Untrammeled
Indicator: Actions not authorized by the Federal land manager that manipulate the biophysical environment
Measure: Acres of wilderness burned due to human-caused wildfires.

♦ Context: While campfires are not allowed on wilderness, unnaturally-caused wildfires are still a possibility. Visitors to the wilderness have varying degrees of refuge use restrictions and sometimes do not realize they are on refuge or wilderness lands (particularly when visitors arrive via the Colorado River). Therefore, illegal campfires occur.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data	Significant Change[1]	Confidence in Data Quality[2]
High	Imperial NWR Fire Crew	Inquiry to the fire operations specialist	Any	High

[1]Significant Change: (how it was determined)	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it. Any more or less unnatural wildfires would be a significant change in the data especially because campfires are prohibited on the refuge.
[2]Data Adequacy:	There is high confidence in the quality of this data because this is easily monitored and the fire management team keeps records on this data.

Quality: Natural
Indicator: Plant and animal species and communities
Measure: Number of bat species present in wilderness.

♦ Context: It is suspected that the diversity of bat species present on the refuge was much lower prior to the development of mines on the refuge. Several of the bat species now found on the refuge are rare or endangered, so the habitat created by these man-made mine structures was considered a positive impact for these species and on the diversity of the area. Therefore an increase in this data point would indicate an improving trend in the wilderness' character.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data[1]	Significant Change[2]	Confidence in Data Quality[3]
High	Refuge biologist, zone biologist	Inquiries to the refuge biologist, zone biologist, and Arizona Game and Fish Department	Any	High

[1]Process to Gather Data:	Compiled visual and acoustic detection data that occurred within the Imperial National Wildlife Refuge in the last 5 years.
[2]Significant Change: (how it was determined)	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it. The introduction or extirpation of even one of these rare species is considered a significant enough change to the wilderness to indicate an improving or degrading trend (respectively) in its character.
[3]Data Adequacy:	There is high confidence in the quality of this data because this data was taken from primary sources which documented the species acoustically and/or visually.

Pallid bat, (*Antrozous pallidus*), Molly McCarter (2011).

Leaf-nosed bat, (*Macrotus californicus*), Molly McCarter (2011).

Quality: Natural
Indicator: Plant and animal species and communities
Measure: Number of non-indigenous species in wilderness.

♦ Context: Non-indigenous species (those that occur in an area by modern influence) may significantly alter the composition, structure, and function of natural communities, thereby degrading or eliminating indigenous species and altering animal habitat. The feral burro is the most degrading non-indigenous species to the Imperial Refuge Wilderness (see photographs below of feral burro trails in fragile desert pavement). Little research into which non-indigenous species exist in the wilderness has been conducted, so new discoveries of established non-native species may occur in the future which could result in a false degrading trend.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data	Significant Change[1]	Confidence in Data Quality[2]
High	Refuge biologist, zone biologist	Inquiries to the refuge biologist, zone biologist, and Arizona Game and Fish Department	Any	Medium

[1]**Significant Change: (how it was determined)**	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it. This data is likely to change in response to climate change, so even one additional introduction of a species would be significant enough to indicate a degrading trend in the wilderness' character.
[2]**Data Adequacy:**	There is a medium level of confidence in the quality of this data because while the six species represented by the 2011 data point have all been confirmed in wilderness, more likely exist. To increase the accuracy of this data, it is suggested that a thorough census of the non-indigenous species in wilderness be conducted. Also calculating the acres of wilderness that these species of concern reside in and using this as the measure rather than a species count would better represent their effect on the wilderness character.

Feral burro trail in desert pavement, Molly McCarter (2011).

Feral burro trails in desert pavement, Molly McCarter (2011).

Quality: Natural
Indicator: Plant and animal species and communities
Measure: Status of species of concern.

♦ Context: Several species of concern exist on the Imperial National Wildlife Refuge. Species population count data is currently not collected, but a monitoring protocol is expected for implementation in the near future. This measure should be edited to fit the monitoring protocol when implemented.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data[1]	Significant Change[2]	Confidence in Data Quality[3]
High	TBD	TBD	TBD	TBD

*Fields are to be determined when monitoring protocol is established/ implemented.

Sonoran Desert Tortoise, a species of concern, FWS.

Quality: Natural
Indicator: Plant and animal species and communities
Measure: Average percentage of vegetation utilized by burros in washes that include wilderness.

♦ Context: The invasive feral burro (Equus asinus) is very destructive to the natural composition and structure of the Imperial Refuge Wilderness ecosystem. The most destructive habit of the burro is its heavy grazing on native plant species such as the honey mesquite (Prosopis glandulosa var. torreyana). Each December, the regional damage to vegetation by burros is assessed. Native plant species in several Imperial NWR washes are surveyed for burro utilization, hedging, and bark stripping. Utilization demonstrates the greatest impact on these plants.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data[1]	Significant Change[2]	Confidence in Data Quality[3]
High	Zone biologist	Inquiry to the zone biologist	10 %	High

[1]**Process to Gather Data:**	Approximately 10 washes are selected for surveying annually. Refuge staff survey within the wash starting from a reference point near the Colorado River out to one mile. There are 100 points within this one mile. 100 points within this mile are assessed for utilization, hedging and bark stripping on five key species of plants. This is a tool used to help refuge staff evaluate when burros numbers are too high based on their damage to the vegetation.
[2]**Significant Change: (how it was determined)**	A 10 percent increase or decrease in the utilization of natural vegetation by burros would be significant enough to indicate a degrading or improving trend in wilderness character for this measure. This significant change was determined by the refuge biologist.
[3]**Data Adequacy:**	This data comes from surveys performed by highly knowledgeable staff.

Quality: Natural
Indicator: Plant and animal species and communities
Measure: Number of extirpated indigenous plant and animal species.

♦ Context: The loss or extirpation of indigenous species from a wilderness profoundly affects public understanding and experience of that area. This is especially the case with the only known extirpated species: the Sonoran pronghorn (Antilocarpa Americana), a charismatic endangered species. There was some debate in determining whether this species historically occupied the Imperial Refuge Wilderness, but it was finally decided that it did occur in the area since it is common belief that it occurred in neighboring Kofa Refuge Wilderness and therefore would have likely ventured to the Colorado River as an abundant water source in an area where so few water sources exist. This was confirmed with local species experts. Other species in danger of extirpation include the red bat, yellow bat, and riparian nesters because of the lack of native cottonwood/willow habitat.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data[1]	Significant Change[2]	Confidence in Data Quality[3]
High	Refuge biologist, zone biologist	Inquiries to the refuge biologist, zone biologist, and Arizona Game and Fish Department	10 %	Medium

[1]Process to Gather Data:	Additional research into the historic range of the Sonoran pronghorn, which proved futile.
[2]Significant Change: (how it was determined)	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it. This data is likely to change in response to climate change, so even one additional extirpation of a species would be significant enough to indicate a degrading trend in the wilderness' character.
[3]Data Adequacy:	There is a medium level of confidence in the quality of this data because it is only suspected that the Sonoran pronghorn (the only extirpated species represented by this data point at this time) resided in the Imperial Refuge Wilderness. It is also possible that other species have been extirpated from the wilderness but this information is not known at this time.

Quality: Natural
Indicator: Physical resources
Measure: Air Quality Data

♦ Context: This measure and data are to be entered by the I&M Program.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data	Significant Change	Confidence in Data Quality
High	TBD	TBD	TBD	TBD

*Fields are to be determined when data is available.

Quality: Natural
Indicator: Biophysical resources
Measure: Percent of mines or other bat habitats in wilderness confirmed with white-nose syndrome.

♦ Context: This is a disruption of natural biophysical processes in wilderness. The disease is not currently evident in the Imperial Refuge Wilderness, but it is feared that it could come into the area. Preventative measures are being taken.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data	Significant Change[1]	Confidence in Data Quality[2]
High	Refuge biologist	Inquiry to the refuge biologist	Any	High

[1]**Significant Change: (how it was determined)**	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it. At present, the disease does not exist anywhere in wilderness. Therefore, the introduction of the disease in just one bat habitat location would be a severe degradation in the wilderness' character.
[2]**Data Adequacy:**	There is high confidence in the quality of this data because this is easily monitored and the refuge biologist keeps records on this data.

Blooming cactus on Imperial National Wildlife Refuge, FWS.

Quality: Undeveloped
Indicator: Non-recreational structures, installations, and developments
Measure: Number of mines with bat gates or mine safety structures.

♦ Context: As evidenced by the photograph, these structures are very visible to any individual in their proximity and are clear evidence of human modification. The number of bat gates is likely to increase and therefore show a degrading trend in wilderness character since all mines with bat presence will need gates in future. These structures are necessary to deter anthropogenic disturbance to the sensitive species. While bat gates are a development in wilderness and degrade wilderness character for this quality, these gates provide protection to bat species and aid in preventing possible exposure to white-nose syndrome. The beneficial impacts of these gates outweigh the degrading impacts.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data[1]	Significant Change[2]	Confidence in Data Quality[3]
High	Refuge biologist	Inquiry to the refuge biologist	Any	High

[1]**Process to Gather Data:**	Mine locations with gates are mapped as a GIS layer.
[2]**Significant Change: (how it was determined)**	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it. As evidenced by the photograph, these structures are very visible to any individual in their proximity and are clear evidence of human modification. Therefore, the addition of even one such structure would degrade the wilderness character of every point surrounding the structure where the structure can be seen.
[3]**Data Adequacy:**	There is high confidence in the quality of this data because this is easily monitored and new constructions/installments are recorded.

Bat gate in wilderness, Molly McCarter (2011).

Quality: Undeveloped
Indicator: Non-recreational structures, installations, and developments
Measure: Number of actions at separate locations to remove modern man-made debris in wilderness (including abandoned property, mine-era waste, and signs).

♦ Context: Many locations with man-made debris exist in wilderness, but it would require significant refuge effort to document all of these developments. Therefore, a measure documenting their removal was selected instead. As this number increases, an improving trend in wilderness character would occur since the number of wilderness developments would decrease.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data	Significant Change[1]	Confidence in Data Quality[2]
High	Refuge manager, refuge biologist, complex law enforcement staff	Inquiries to the refuge manager, refuge biologist, complex law enforcement staff	Any	High
[1]Significant Change: (how it was determined)	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it. Any reduction in the number of developments in wilderness would be a great improvement in its character.			
[2]Data Adequacy:	There is high confidence in the quality of this data because since the frequency of this data is one year, it is easy for staff to remember whether developments have been removed from wilderness.			

Wooden water hauling structure in wilderness near Watchman's Cabin, Molly McCarter (2011).

Abandoned vehicle in Imperial Refuge Wilderness, Kelly Lockman (2011).

Quality: Undeveloped
Indicator: Non-recreational structures, installations, and developments
Measure: Number of cabins, corrals, and other man-made structures within wilderness.

♦ Context: As evidenced by the photographs below, these man-made structures are very visible to any individual in their proximity and are clear evidence of human occupation and modification. Most of these structures existed before wilderness and refuge designation.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data[1]	Significant Change[2]	Confidence in Data Quality[3]
High	Refuge biologist, refuge manager	Inquiry to the refuge biologist	Any	Medium

[1]Process to Gather Data:	Visits to wilderness to document structures.
[2]Significant Change: (how it was determined)	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it. It is not expected that additional structures will be constructed in wilderness, but if they are this would greatly degrade the wilderness' character. Likewise, the removal of any structure in wilderness would greatly improve the wilderness' character.
[3]Data Adequacy:	There is a medium level of confidence in the quality of this data because not all of the potential wilderness structures have been visited and assessed for location with respect to the wilderness boundary. In order to increase the accuracy of this data, it is suggested that an inventory of all wilderness structures be compiled and GPS coordinates be taken of each so that their location can be accurately determined.

Red Cloud Corral, Molly McCarter (2011).

Structure Foundation at Mayflower Mines. Photo Source: Molly McCarter (2011).

Quality: Undeveloped
Indicator: Inholdings
Measure: Acres of inholdings within wilderness.

♦ Context: There are two inholdings that partially extend into the wilderness boundary: (1) Clip Mill and (2) Norton's Landing. The largest portion of each inholding is outside the wilderness boundary but in refuge. It is expected that this measure will not change in the future and therefore always indicate a stable trend in wilderness character. The size of the inholdings is not expected to change.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data[1]	Significant Change[2]	Confidence in Data Quality[3]
High	Refuge biologist, refuge manager	Refuge maps	Any	High

[1]Process to Gather Data:	Using a GIS map and relevant layers, calculated the area of inholdings within the wilderness.
[2]Significant Change: (how it was determined)	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it. Any addition of inholdings within the wilderness boundary would be a degradation of its character because inholdings interior to designated wilderness are not given the same protections as the wilderness lands around them. These lands can be developed for various purposes without consideration to wilderness character.
[3]Data Adequacy:	There is high confidence in the quality of this data because the location of the inholdings with respect to the wilderness boundary is known. GIS calculation of area of inholdings within the wilderness boundary yielded a highly accurate data point.

Quality: Undeveloped
Indicator: Inholdings
Measure: Miles of wilderness boundary adjacent to inholdings.

♦ Context: There are two inholdings that partially extend into the wilderness boundary: (1) Clip Mill and (2) Norton's Landing. The largest portion of each inholding is outside the wilderness boundary but in refuge. This measure measures how much of the inholding outside of wilderness touches the wilderness boundary. It is expected that this measure will not change in the future and therefore always indicate a stable trend in wilderness character.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data[1]	Significant Change[2]	Confidence in Data Quality[3]
Medium	Refuge biologist, refuge manager	Refuge maps	Any	High

[1]Process to Gather Data:	Using a GIS map and relevant layers, calculated the miles of wilderness boundary that is adjacent to inholdings.
[2]Significant Change: (how it was determined)	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it. Inholdings can be developed for various purposes at the discretion of the landowner and thereby have a large impact on the surrounding wilderness. Additional boundary adjacent to inholdings would also affect the solitude quality of the wilderness.
[3]Data Adequacy:	There is high confidence in the quality of this data because the location of the inholdings with respect to the wilderness boundary is known. GIS calculation of miles of inholdings adjacent to the wilderness boundary yielded a highly accurate data point.

Quality: Undeveloped
Indicator: Use of motor vehicles, motorized equipment, or mechanical transport
Measure: Number of unauthorized motorized/mechanical uses.

♦ Context: The primary source of unauthorized motorized/mechanical use in wilderness is illegal off road vehicle use which is considered to be one of the greatest degradations to the character of the Imperial Refuge Wilderness. Off road vehicle use contributes to loss of fragile desert pavement other general ground surface and habitat disturbance. Vehicle tracks remain on the ground for an extensive time after the damage is created. Another unauthorized use of concern is low-level military flights, but this use is not currently tracked by refuge staff. The data for this measure will be the best data that is already annually collected (primarily from Uniform Crime Reports) with little additional refuge staff effort.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data[1]	Significant Change[2]	Confidence in Data Quality[3]
High	Uniform Crime Report (UCR), available from complex law enforcement staff	Inquiry to complex law enforcement	Any	Low

[1]**Process to Gather Data:**	Data is compiled annually (ending in December) in the UCR.
[2]**Significant Change: (how it was determined)**	It was the refuge biologist's opinion that any increase in the illegal off road activity (even one more vehicle contributing to the off road tracks in wilderness) would indicate a degrading trend in wilderness character.
[3]**Data Adequacy:**	There is low level of confidence in the quality of this data because currently this data point only reflects the off road vehicle use violations that are reported and recorded in the Uniform Crime Reports. It would be near impossible to accurately calculate all such uses that occur within the wilderness boundary, but this data could be improved. In order to improve the accuracy of this data, it is suggested to implement greater law enforcement and further discouragement of illegal off road vehicle use. Increased monitoring of off road vehicle use could also occur by the use of cameras at known high-entry locations.

Although this picture of vehicle tracks in wilderness was taken in 2011, these tracks have likely not been used for several years - evidence that vehicle tracks remain on the ground far beyond the time they are created, Molly McCarter (2011).

Quality: Undeveloped
Indicator: Loss of statutorily protected cultural resources
Measure: Number of anthropogenic and/or wildlife-caused disturbances to prehistoric cultural resource sites.

♦ Context: There are many archeologically significant sites on the Imperial Refuge Wilderness such as petroglyphs, sleeping circles of ancient peoples, and Native American campgrounds. There are no known sites on Imperial Refuge Wilderness that are registered on the National Registrar of Historic Places. Noted disturbances to cultural resources include vandalism and burro wallowing. Not all cultural resource sites on the Imperial Refuge Wilderness were visited, inventoried, and assessed for damage. It is strongly suggested that an inventory of the cultural resource sites in the wilderness be documented, assessed for damage, and monitored.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data[1]	Significant Change[2]	Confidence in Data Quality[3]
High	Refuge manager, refuge biologist	Inquiries to cultural resource specialists	Any	Low

[1]**Process to Gather Data:**	Inquiry to the refuge biologist, regional cultural resources representative, and local experts. Visited several known cultural sites and assessed damage.
[2]**Significant Change: (how it was determined)**	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it. The culturally significant sites in the Imperial Refuge Wilderness are abundant and each considerably adds to the historic character of the wilderness. Therefore any loss or degradation of these sites would affect the wilderness character.
[3]**Data Adequacy:**	There is low level of confidence in the quality of this data because field work has not been conducted to determine this data. While all of the cultural resource sites that were visited were disturbed (as reflected by the 2011 data point), all cultural sites that exist within the wilderness boundary were not visited and assessed for damage. In order to improve the accuracy of this data in the future, it is suggested that all the cultural resources sites be visited, documented, their location be determined with respect to the wilderness boundary using GPS coordinates, and assessed for damage.

Petroglyph rock with modern scratches and carvings, Molly McCarter (2011).

Recent additional rock placement within archeological rock circles. Such patterns as "smiley faces" have been placed inside rock circles, Molly McCarter (2011).

Quality: Undeveloped
Indicator: Loss of statutorily protected cultural resources
Measure: Number of anthropogenic and/or wildlife-caused disturbances to historic cultural resource sites (settlement activities).

♦ Context: Several sites associated with settlement activities are present on the Imperial Refuge Wilderness including several cabins. It is strongly suggested that an inventory of these sites in the wilderness be documented, assessed for damage, and monitored.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data[1]	Significant Change[2]	Confidence in Data Quality
High	Refuge manager, refuge biologist	Inquiries to cultural resource specialists, refuge management	Any	TBD

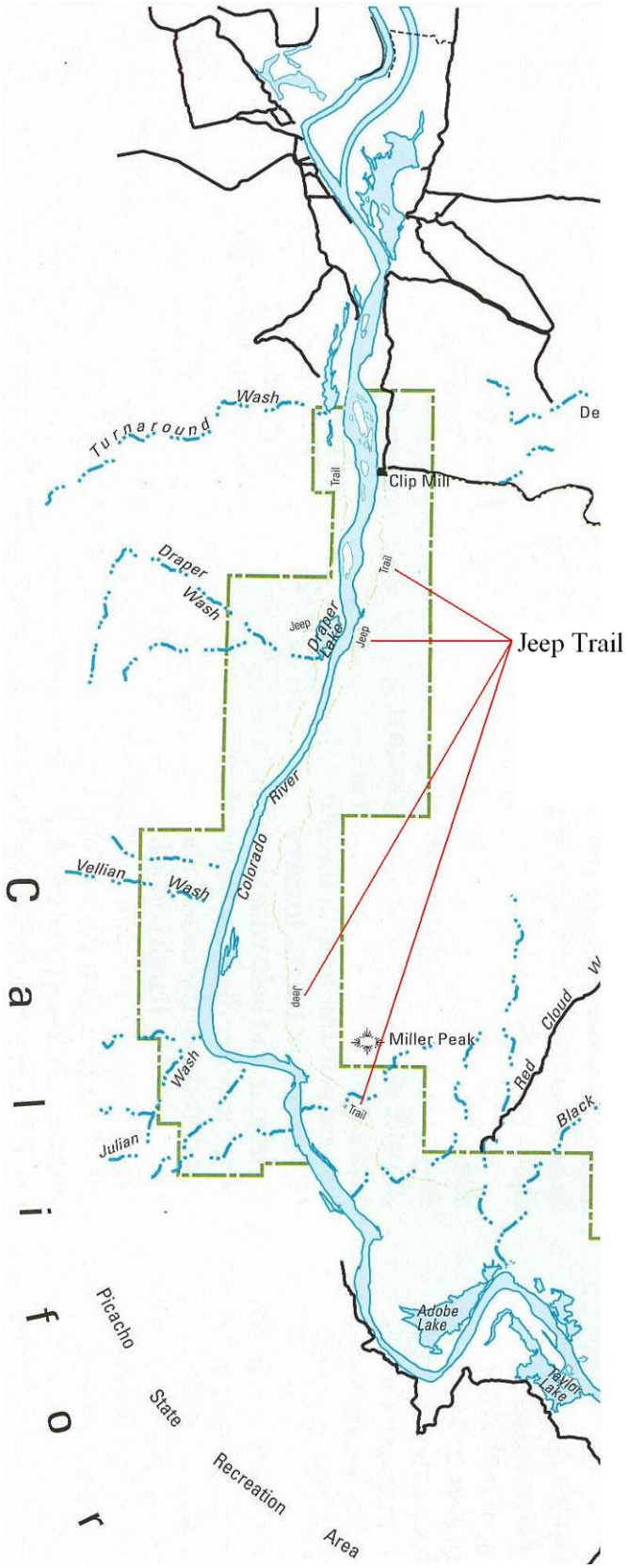
[1]Process to Gather Data:	The historical significance of these sites needs to be assessed as well as any damage that might have occurred to them.
[2]Significant Change: (how it was determined)	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it. The culturally significant sites in the Imperial Refuge Wilderness are abundant and each considerably adds to the historic character of the wilderness. Therefore any loss or degradation of these sites would affect the wilderness character.

Quality: Solitude or Primitive and Unconfined Recreation
Indicator: Remoteness from sights and sounds of people inside the wilderness
Measure: Miles of trails and roads within wilderness.

♦ Context: Illegal off road vehicle use is considered to be one of the greatest degradations to the character of the Imperial Refuge Wilderness. Some "roads" have been established in the wilderness due to recurrent use of trails made by these illegal off road vehicles. These vehicle tracks remain on the ground for an extensive time after the damage is created. Another source of wilderness roads is a historically-used jeep trail which is still designated on many modern topographic maps despite its no longer being a designated road.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data[1]	Significant Change[2]	Confidence in Data Quality[3]
High	Refuge biologist. Aerial maps and wilderness roads GIS layer	Inquiries to refuge staff	Any	High

[1]**Process to Gather Data:**	Inquired to staff about the presence of roads in wilderness to determine approximate locations. Viewed high definition aerial map of wilderness and topographic maps to located roads and determine whether or not they extended into the wilderness boundary. Created a "wilderness roads" GIS layer which maps the roads that are visible by on this aerial map. Calculated the miles of roads in wilderness.
[2]**Significant Change: (how it was determined)**	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it. Evidence of roads in wilderness is one of the most degrading impacts to wilderness character and significantly affects the solitude and primitive recreation qualities of the wilderness. Therefore, the addition or removal of any of these roads would significantly degrade or improve (respectively) the wilderness character.
[3]**Data Adequacy:**	There is high confidence in the quality of this data because GIS calculation of miles of roads within the wilderness boundary yielded a highly accurate data point.



Refuge map from Imperial NWR pamphlet showing old jeep trail that goes through wilderness, FWS.

Quality: Solitude or Primitive and Unconfined Recreation
Indicator: Remoteness from occupied and modified areas outside the wilderness
Measure: Number of man-made structures visible from wilderness.

♦ Context: Several structures exist that are visible from wilderness but are not within the wilderness boundary and therefore affect visitors' opportunities for solitude. These structures include mine-era cabins, Picacho State Park, and an inholding adjacent to wilderness that includes several man-made structures. Even though managers may not be able to take actions to mitigate this disturbance to the solitude quality of the wilderness, they are still documented because they nonetheless diminish wilderness character.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data[1]	Significant Change[2]	Confidence in Data Quality[3]
High	Refuge manager, refuge biologist	Inquiry to the refuge biologist	Any	Medium

[1]**Process to Gather Data:**	Visits to wilderness to document structures.
[2]**Significant Change: (how it was determined)**	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it. It is possible that development of land surrounding the wilderness could increase in the future since much of this land is not controlled by the Fish and Wildlife Service. This development would greatly degrade the solitude quality of the wilderness. Therefore any addition or removal of developments that are visible from wilderness would degrade or improve (respectively) the character of the wilderness.
[3]**Data Adequacy:**	There is a medium level of confidence in the quality of this data because field work has not been conducted to determine the visibility of man-made structures from wilderness. In order to improve the accuracy of this data, it is suggested that such field work be conducted.

Quality: Solitude or Primitive and Unconfined Recreation
Indicator: Remoteness from occupied and modified areas outside the wilderness
Measure: Number of authorized aerial uses over wilderness.

♦ Context: The primary source of this use is aerial species surveys for wildlife management. These actions are conducted by the FWS and other government agencies. This measure encompasses aerial motorized/mechanical uses such as those used for emergency and wildlife management purposes (helicopters for aerial surveys, burro gathers).

Relevance to Indicator (High/Medium/Low)	Data Source(s)[1]	Process to Gather Data[2]	Significant Change[3]	Confidence in Data Quality[4]
Medium	Regional specialists from multiple agencies	Inquiries to the zone biologist and complex law enforcement	Any	Medium

[1]**Data Sources:**	Source for Wildlife Management Purposes - Refuge biologist, zone biologist; info for burro gathers from BLM; AZGFD for info on bighorn sheep aerial surveys. Source for other aerial uses – refuge manager, fire management team, complex law enforcement.
[2]**Process to Gather Data:**	Compilation of uses into refuge document.
[3]**Significant Change: (how it was determined)**	I suggested this significant change in the data to refuge staff and the refuge manager confirmed it.
[3]**Data Adequacy:**	There is a medium level of confidence in the quality of this data because the data only captures aerial uses for wildlife surveying purposes. Additional aerial uses occur by the military; refuge lands are surrounded by Yuma Proving Grounds and other military lands.

Quality: Solitude or Primitive and Unconfined Recreation
Indicator: Facilities that decrease self-reliant recreation
Measure: Number of agency-provided recreation facilities.

♦ Context: While no such facilities exist in the wilderness today, it is possible that such facilities could be implemented for resource protection or visitor convenience (particularly if visitor use increases). Such facilities would degrade the perceived opportunity for primitive and unconfined recreation, but could improve the natural quality of the wilderness if such structures are made to protect fragile desert pavement, cultural resources, or native vegetation.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data	Significant Change[1]	Confidence in Data Quality[2]
High	Refuge manager	Inquiry to the refuge manager. Reading refuge files	Any	High

[1]Significant Change: (how it was determined)	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it. No such facilities currently exist in the Imperial Refuge Wilderness, but if such facilities were added in the future this would greatly degrade the primitive recreation quality of the wilderness. Likewise, the removal of any facility in wilderness after its addition would greatly improve the wilderness' character.
[2]Data Adequacy:	There is high confidence in the quality of this data because this is common refuge knowledge. If facilities were to be constructed in the future, this would be documented in refuge records.

Quality: Solitude or Primitive and Unconfined Recreation
Indicator: Management restrictions on visitor behavior
Measure: Acres where camping is not allowed.

♦ Context: Camping is currently not allowed anywhere on the Imperial NWR as a means to reduce human impact on the environment. If designated campsites are created in the future, an improving trend for this measure would be indicated, but a degrading trend might be indicated in the "Number of agency-provided recreation facilities" measure. It is believed that creating designated campsites so that this primitive skill could be practiced would be a more positive than negative impact on the wilderness' character.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data	Significant Change[1]	Confidence in Data Quality[2]
High	Refuge manager	Inquiry to the refuge manager. Reading refuge files	Any	High

[1]**Significant Change: (how it was determined)**	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it. Since camping is not allowed anywhere on the Imperial Refuge Wilderness, allowing this primitive skill on any amount of acres in the wilderness would greatly improve the wilderness' character.
[2]**Data Adequacy:**	There is high confidence in the quality of this data because this is common refuge knowledge. If camping were to be allowed in the future, the acreage would be documented in refuge records.

Entrance sign to Imperial NWR describing permitted and prohibited uses, Molly McCarter (2011).

Quality: Solitude or Primitive and Unconfined Recreation
Indicator: Management restrictions on visitor behavior
Measure: Acres where campfires are not allowed.

♦ Context: Campfires are currently not allowed anywhere on the Imperial NWR as a means of wildfire prevention in the dry desert climate and to reduce overall environmental impact such as firewood collection and creation of fire rings.

Relevance to Indicator (High/Medium/Low)	Data Source(s)	Process to Gather Data	Significant Change[1]	Confidence in Data Quality[2]
High	Refuge manager	Inquiry to the refuge manager. Reading refuge files	Any	High

[1]**Significant Change: (how it was determined)**	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it. Since campfires are not allowed anywhere on the Imperial Refuge Wilderness, allowing this primitive skill on any amount of acres in the wilderness would greatly improve the wilderness' character.
[2]**Data Adequacy:**	There is high confidence in the quality of this data because this is common refuge knowledge. If campfires were to be allowed in the future, the acreage would be documented in refuge records.

Quality: Solitude or Primitive and Unconfined Recreation
Indicator: Management restrictions on visitor behavior
Measure: Acres where hunting is not allowed.

♦ Context: A small portion of the Imperial NWR is restricted from hunting to provide an undisturbed area for wildlife.

Relevance to Indicator (High/Medium/Low)	Data Source(s)[1]	Process to Gather Data	Significant Change[2]	Confidence in Data Quality[3]
High	Refuge manager, refuge biologist	Refuge maps	Any	High

[1]Data Source(s):	Used GIS map and relevant layers to calculate the area within the wilderness where hunting is prohibited.
[1]Significant Change: (how it was determined)	I suggested this significant change in the data to refuge staff and the refuge biologist confirmed it.
[2]Data Adequacy:	There is high confidence in the quality of this data because this is common refuge knowledge. GIS calculation of area of inholdings within the wilderness boundary yielded a highly accurate data point. If restricted hunting area were to be increased or reduced in the future, the acreage would be documented in refuge records.

MEASURES NOT USED

Untrammeled Quality

► [Untrammeled – Auth. actions] Gallons of water brought to watering sources within wilderness.

♦ This measure was not included because it is not an issue at this time and is not perceived as an issue in the near future. Should wildlife watering sources become a concern in the future, it is highly recommended that this measure be reintroduced.

♦ Priority: Low

► [Untrammeled – Auth. actions] Acres of wilderness on which pesticides have been used.

♦ This measure was not included because it is not an issue at this time and is not perceived as an issue in the near future. Should pesticide use in wilderness become a practice in the future, it is highly recommended that this measure be reintroduced.

♦ Priority: Low

► [Untrammeled – Auth. actions] Number of actions to transplant wildlife to the wilderness.

♦ This measure was not included because it would likely fall under "Number of authorized motor vehicle, motorized equipment, and mechanical transport uses (including those used for emergency and wildlife management purposes) in or over wilderness."

♦ Priority: Low

► [Untrammeled – Unauth. actions] Citations issued for poaching activities.

♦ This measure was not included because it is not an issue at this time and is not perceived as an issue in the near future. Should poaching become a concern in the future, it is highly recommended that this measure be reintroduced.

♦ Priority: Medium

Natural Quality

► [Natural – Plant and animal communities] Percentage of wilderness acres with invasive plant species that are not indigenous to the wilderness.

♦ This measure was not included because of the difficulty in gathering this data. A loose estimate could have been determined by the refuge biologist, but instead a measure was selected that monitors the number of non-indigenous species existing in the wilderness.

♦ Priority: High

► [Natural – Biophysical processes] Alteration to hydrology due to roads and off road tracks.

♦ Context/Why not used: While this is a concern to the Imperial Refuge staff, monitoring the alteration to hydrology from off road tracks is too difficult to accomplish. A monitoring protocol could not be imagined, and if one were to be created it is likely that it would require too much additional refuge effort to be implemented. If such a monitoring is conducted in the future, this measure should be included into the wilderness character monitoring protocol.

♦ Priority: Medium

Undeveloped Quality

► [Undeveloped – Non rec. structures] Number of unauthorized physical structures/installations/ developments.

♦ This measure was not included because of the difficulty in gathering this data. Instead, a measure was chosen that monitors how many of these developments are removed in order to reduce the addition refuge effort to acquire the data.

♦ Priority: High

► [Undeveloped – Non-rec. structures] Yards of cables, lines, *etc* going into and through wilderness.

♦ This measure was not used because its presence was documented under the measure "Number of cabins, corrals, and other man-made structures within wilderness." Its removal would also be documented under "Number of actions at separate locations to remove man-made structures, installations, developments in wilderness (including mine-era debris and signs)."

♦ Priority: Medium

► [Undeveloped – Non-rec. structures] Number of mines within wilderness.

♦ This measure was not included because additional mines will not be created in wilderness because there are no longer any mineral prospects in the area. If this data measure increased, it would have been because more mines are discovered, not created, which could falsely indicate a degrading trend in wilderness character. If this number decreases because of mine removal, this will be captured by the measure "Number of authorized motor vehicle, motorized equipment, and mechanical transport uses (including those used for emergency and wildlife management purposes) in wilderness" and "Number of actions at separate locations to remove man-made structures, installations, developments in wilderness (including mine-era debris and signs)."

♦ Priority: Medium

Horizontal mines in Imperial Refuge Wilderness, Molly McCarter (2011).

Vertical mine in Imperial Refuge Wilderness, Kelly Lockman (2011).

► [Undeveloped – Non rec. structures] Number of maintenance actions in to upkeep any structures or developments within wilderness (sign replacement, maintenance/repairs to cabins, etc).

♦ This measure was not included because it was considered repetitive. The impact of maintenance to wilderness developments should be captured by either the measures that monitors removal of wilderness structures or the measure that indexes the number of wilderness structures. This measure should be considered for re-inclusion if significant maintenance to wilderness structures is considered (thus curbing the natural disintegration of these structures, which would allow the wilderness to maintain a more "wild" state) or if signs in wilderness, such as the ones pictured below, were replaced.

♦ Priority: Low

Old "No vehicle" sign posts in wilderness that may be replaced, Molly McCarter (2011).

► [Undeveloped – Motor/Mech.] Number of military violations of 2000ft no-fly zone over wilderness

♦ While this is a great concern to refuge management, these incidents are not documented. If these incidents are documented in the future, it is suggested that this measure be reintroduced or be included in the measure "Number of unauthorized motor vehicle, motorized equipment, and mechanical transport uses in or over wilderness."

♦ Priority: High

► [Undeveloped – Cult. res. loss] Number of sites with archeological significance.

♦ This was not included because of the difficulty to in gathering the data (difficult to find all rocks with petroglyphs and other culturally significant sites). Instead, a measure was chosen that monitors how many of the known sites are disturbed. This new measure was considered more appropriate for the measure "Loss of protected cultural resources."

♦ Priority: Medium

Solitude or Primitive and Unconfined Recreation Quality

► [Solitude – Remoteness inside wilderness] Number of trail contacts.

♦ This measure was not used because there are no designated trails within the Imperial wilderness. There is also little visitation to Imperial wilderness, and when visitation is high people are often using vehicles as a means to travel to and within wilderness (which is captured by another measure).

♦ Priority: Low

► [Solitude – Remoteness inside wilderness] Number of visitors to wilderness.

♦ This measure was not used because its importance to the wilderness character is low. A small percentage of refuge visitors visit wilderness and most visitors to wilderness access it via the river on recreational boating visits, a type of visitation very difficult for refuge staff to monitor. A loose estimate could have been made at best. If higher visitation occurs in the future, it is highly recommended that this measure be reintroduced.

♦ Priority: Low

► [Solitude – Remoteness outside wilderness] Average night sky visibility over wilderness.

♦ This measure was not included because this data is currently not collected on the wilderness scale and would require too much additional refuge effort to collect. A lack of practical protocol to collect this data also contributed to the exclusion of this measure. It is expected that the night sky visibility in the wilderness will degrade in the future due to development of adjacent Yuma Proving Grounds. If this is perceived to be a great degradation to the wilderness' character in the future, it is highly recommended that a monitoring protocol be established and the measure be reintroduced.

♦ Priority: Medium

► [Solitude – Remoteness outside wilderness] Decibels of noise from mechanized and motorized vehicles occupying/occurring outside of the wilderness.

♦ Although this measure is highly relevant to the character of the wilderness, this measure was not included because this data is currently not currently collected and would require significant additional refuge effort to collect.

♦ Priority: High

View of Colorado River from Imperial Refuge Wilderness; motorized watercraft noises are clearly audible from the wilderness, Kelly Lockman (2011).

► [Solitude – Visitor restrictions] Number of acres where visitors are not allowed.

♦ This measure was not included because this data would only change (increase) if there was (1) active management going on in the wilderness or (2) a site within the wilderness was designated as a sensitive habitat or feeding area for an endangered species. The first would likely not occur in wilderness, but if it did this would be captured by other measures (such as "Number of authorized motor vehicle, motorized equipment, and mechanical transport uses" or "Number of cabins, corrals, and other wooden, stone, or otherwise man-made structures within wilderness").

♦ Priority: Low

CONCLUSIONS

The wilderness character monitoring protocol used for the selected measures discussed in this document adequately captures the character of Imperial Refuge Wilderness for 2011. The measures selected, although not exhaustive, thoroughly capture the most important qualities of the Imperial Refuge Wilderness' character. This thoroughness was so easily obtained because the Imperial Refuge Wilderness is fairly inaccessible due to rough terrain with no designated vehicle access routes. Therefore active management and other anthropogenic activities that might be degrading to the wilderness' character are limited and the wilderness' untrammeled quality is preserved. Should this change in the future, this protocol should be updated appropriately. Primary access to the Imperial Refuge Wilderness is via the Colorado River and prohibited off road vehicles.

Monitoring of the illegal off road vehicle use, while one of the most degrading activities to the wilderness' character, is an area where this character monitoring is lacking. Off road vehicle use is monitored by this protocol to the refuge's best capability based on current refuge monitoring. For the future, I suggest greater law enforcement and further discouragement of illegal off road vehicle use. Monitoring of this off road vehicle use could also be increased by the use of cameras at known high-entry locations.

Other serious degradations to the wilderness are the numerous impacts of wild burro presence in the Imperial Refuge Wilderness. These burros graze heavily on native plants, disturb fragile desert pavement, and damage cultural resource sites. This degradation is likely to continue into the future because the burros are statutorily protected by the 1971 Wild Free-Roaming Horse and Burro Act.

I anticipate that this wilderness character monitoring protocol, using the selected measures will be easily implemented. All of the measures selected require little to no additional data collection efforts from refuge staff; almost all of the data associated with the selected measures is already collected annually by refuge staff.

Feral burro among burro trails, Molly McCarter (2011).

APPENDICES

Appendix A - Worksheet: Priority ranking of potential measures

Instructions

A. Level of importance (the measure is highly relevant to the quality and indicator of wilderness character, and is highly useful for managing the wilderness):

High = 3 points, Medium = 2 points, Low = 1 point

B. Level of vulnerability (measures an attribute of wilderness character that currently is at risk, or might likely be at risk over 10-15 years):

High = 3 points, Medium = 2 points, Low = 1 point

C. Degree of reliability (the measure can be monitored accurately with a high degree of confidence, and would yield the same result if measured by different people at different times):

High = 3 points, Medium = 2 points, Low = 1 point

D. Degree of reasonableness (the measure is related to an existing effort or could be monitored without significant additional effort):

High = 1 point, Low = 0 point

Untrammeled Quality

	Criteria for Prioritizing Potential Measures				
Potential Measure	A. Importance	B. Vulnerability	C. Reliability	D. Reasonableness	OVERALL SCORE
Indicator: Actions **authorized** by the federal land manager that manipulate the biophysical environment Measure: **Percent of naturally started fires that received a suppression response.**	3	2	3	1	9

Potential Measure	Criteria for Prioritizing Potential Measures				OVERALL SCORE
	A. Importance	B. Vulnerability	C. Reliability	D. Reasonableness	
Indicator: Actions **authorized** by the federal land manager that manipulate the biophysical environment Measure: **Number of burros that are captured and removed from wilderness (Burro "gathers")**	2	3	3	1	9
Indicator: Actions **authorized** by the federal land manager that manipulate the biophysical environment Measure: **Number of actions to trammel species in wilderness (including actions for surveys or research).**	3	1	3	1	8
Indicator: Actions **not authorized** by the Federal land manager that manipulate the biophysical environment Measure: **Acres of wilderness burned due to human-caused wildfires**	3	2	3	1	9

Natural Quality

Potential Measure	Criteria for Prioritizing Potential Measures				OVERALL SCORE
	A. Importance	B. Vulnerability	C. Reliability	D. Reasonableness	
Indicator: Plant and animal species and communities Measure: **Number of bat species present in wilderness**	3	3	2	1	9
Indicator: Plant and animal species and communities Measure: **Number of non indigenous species in wilderness. (e.g., stocked fish, livestock, invertebrates, fungi, pathogens, or plants) of concern that are not indigenous to the wilderness**	3	3	3	1	10
Indicator: Plant and animal species and communities Measure: **Average percentage of vegetation utilized by burros in washes that include wilderness.**	3	3	3	1	10
Indicator: Plant and animal species and communities Measure: **Number of extirpated indigenous plant and animal species**	3	3	3	1	10
Indicator: Physical resources Measure: **Air Quality Data**					
Indicator: Biophysical processes Measure: **Number of actions to prevent natural fires**	2	1	3	1	7
Indicator: Biophysical processes	3	2	3	1	9

Potential Measure	Criteria for Prioritizing Potential Measures				
	A. Importance	B. Vulnerability	C. Reliability	D. Reasonableness	OVERALL SCORE
Measure: **Percent of mines or other bat habitats in wilderness confirmed with white-nose syndrome.**					

Undeveloped Quality

Potential Measure	Criteria for Prioritizing Potential Measures				
	A. Importance	B. Vulnerability	C. Reliability	D. Reasonableness	OVERALL SCORE
Indicator: Non-recreational structures, installations, and developments Measure: **Number of mines with bat gates or mine safety structures**	3	3	3	1	10
Indicator: Non-recreational structures, installations, and developments Measure: **Number of actions at separate locations to remove man-made structures, installations, developments in wilderness (including mine-era debris and signs).**	3	2	3	1	9
Indicator: Non-recreational structures, installations, and developments Measure: **Number of cabins, corrals, and other man-made structures**	3	2	3	1	9

Potential Measure	Criteria for Prioritizing Potential Measures				OVERALL SCORE
	A. Importance	B. Vulnerability	C. Reliability	D. Reasonableness	
within wilderness.					
Indicator: Non-recreational structures, installations, and developments Measure: **Number of maintenance actions in to upkeep any structures or developments within wilderness (sign replacement, maintenance/repairs to cabins, etc).**	3	2	3	1	9
Indicator: Inholdings Measure: **Number of inholdings within wilderness**	2	1	3	1	7
Indicator: Inholdings Measure: **Number of inholdings adjacent/proximate to wilderness**	3	1	3	1	8
Indicator: Use of motor vehicles, motorized equipment, or mechanical transport Measure: **Number of unauthorized motor vehicle, motorized equipment, and mechanical transport uses (including citations issued off-road vehicle activity and known violations without issued citations in wilderness).**	3	3	3	1	10
Indicator: Use of motor vehicles, motorized equipment, or mechanical transport Measure: **Number of authorized motor vehicle, motorized equipment, and mechanical transport uses (including those used for emergency and wildlife**	2	2	3	1	8

Potential Measure	Criteria for Prioritizing Potential Measures				OVERALL SCORE
	A. Importance	B. Vulnerability	C. Reliability	D. Reasonableness	
management purposes) in wilderness.					
Indicator: Loss of statutorily protected cultural resources Measure: **Number of anthropogenic and/or wildlife-caused disturbances to cultural resources.**	3	3	2	1	9

Solitude or Primitive and Unconfined Recreation

Potential Measure	Criteria for Prioritizing Potential Measures				OVERALL SCORE
	A. Importance	B. Vulnerability	C. Reliability	D. Reasonableness	
Indicator: Remoteness from sights and sounds of people inside the wilderness Measure: **Miles of trails and roads within wilderness**	3	3	2	1	9
Indicator: Remoteness from occupied and modified areas outside the wilderness Measure: **Number of man-made structures visible from wilderness**	3	3	3	1	10
Indicator: Remoteness from occupied and modified areas outside the wilderness Measure: **Incidents of machinery or mechanized equipment used for**	3	2	3	1	9

Potential Measure	Criteria for Prioritizing Potential Measures				OVERALL SCORE
	A. Importance	B. Vulnerability	C. Reliability	D. Reasonableness	
maintenance or structure removal adjacent to wilderness					
Indicator: Facilities that decrease self-reliant recreation Measure: **Number of agency-provided recreation facilities**	3	1	3	1	8
Indicator: Management restrictions on visitor behavior Measure: **Number of acres where camping is not allowed**	3	3	3	1	10
Indicator: Management restrictions on visitor behavior Measure: **Number of acres where campfires are not allowed**	3	3	3	1	10
Indicator: Management restrictions on visitor behavior Measure: **Number of acres where hunting is not allowed**	3	3	3	1	10

Names of team members filling out this worksheet:

► Molly McCarter, Wilderness Character Monitoring Intern

► Joseph Barnett, Imperial National Wildlife Refuge Biologist

Appendix B - Spreadsheets: Effort Required For Wilderness Character Monitoring

Effort per Measure

Quality	Indicator	Measure	Were data gathered from office paper files, computer files, or field work (professional judgment is an option)?	Time you spent gathering data for each measure (in whole hours)	Comments
Untrammeled	Authorized actions	Percent of naturally started fires that received a suppression response.	Imperial NWR Fire Crew	1	Hour meeting included inquiries about several measures. Would take minimal time inquiring about this in the future.
Untrammeled	Authorized actions	Number of burros that are captured and removed from wilderness (Burro "gathers")	Refuge biologist, regional biologist	1	Hour meeting included inquiries about several measures. Would take minimal time inquiring about this in the future.
Untrammeled	Authorized actions	Number of actions to trammel species in wilderness (including actions for surveys or research	Refuge biologist, regional biologist	1	Hour meeting included inquiries about several measures. Would take minimal time inquiring about this in the future.
Untrammeled	Unauthorized actions	Acres of wilderness burned due to human-caused wildfires	Imperial NWR Fire Crew	1	Hour meeting included inquiries about several measures. Would take minimal time inquiring about this in the future.
Natural	Plant and animal species	Number of bat species present in wilderness	Refuge biologist, regional biologist, "Monitoring of Covered and Evaluation Bat Species for the LCR MSCP" Annual Reports.	3	Initial data gathering took a quite some time, but it is expected that future gathering will not take as long since initial gathering is complete. Compiled data into INWR File 40.50 "Wilderness Character Monitoring."

Natural	Plant and animal species	Number of non indigenous species in wilderness. (e.g., stocked fish, livestock, invertebrates, fungi, pathogens, or plants) of concern that are not indigenous to the wilderness	Refuge biologist, regional biologist, refuge file 40.51: Exotic/Invasive Species Survey.	3	Initial data gathering took a quite some time, but it is expected that future gathering will not take as long since initial gathering is complete. Compiled data into INWR File 40.50 "Wilderness Character Monitoring."
Natural	Plant and animal species	Average percentage of vegetation utilized by burros in washes that include wilderness.	Regional biologist.		These surveys are conducted annually by refuge staff. Compiling wilderness-relevant data from these surveys takes relatively little time, while actually conducting these surveys takes a large amount of time. Compiled data into INWR File 40.50 "Wilderness Character Monitoring."
Natural	Plant and animal species	Number of extirpated indigenous plant and animal species	Refuge biologist, regional biologist, AZGFD.	2	Initial data gathering took a quite some time, but it is expected that future gathering will not take as long since initial gathering is complete.
Natural	Physical resources	Air Quality Data			
Natural	Biophysical processes	Percent of mines or other bat habitats in wilderness confirmed with white-nose syndrome	Refuge biologist	1	Meeting included inquiries about several measures. Would take minimal time inquiring about this in the future.
Undeveloped	Non-recreational structures, installations, and developments	Number of mines with bat gates or mine safety structures	Refuge biologist, maps	1	Meeting included inquiries about several measures. Would take minimal time inquiring about this in the future.

Undeveloped	Non-recreational structures, installations, and developments	Number of actions at separate locations to remove modern man-made debris in wilderness (including abandoned property, mine-era waste, and signs).	Refuge biologist, Complex law enforcement staff	2	Meeting included inquiries about several measures. Would take minimal time inquiring about this in the future.
Undeveloped	Non-recreational structures, installations, and developments	Number of cabins, corrals, and other man-made structures within wilderness.	Refuge biologist, Refuge file 31.40, Field	5	Initial data gathering took a quite some time, but it is expected that future gathering will not take as long since initial gathering is complete. Compiled data into INWR File 40.50 "Wilderness Character Monitoring."
Undeveloped	Non-recreational structures, installations, and developments	Number of maintenance actions in to upkeep any structures or developments within wilderness (sign replacement, maintenance/repairs to cabins, etc)	Complex law enforcement staff	1	Meeting included inquiries about several measures. Would take minimal time inquiring about this in the future.
Undeveloped	Inholdings	Acres of inholdings within wilderness.	Refuge biologist, maps	1	Initial data gathering took a quite some time, but it is expected that future gathering will not take as long since initial gathering is complete.
Undeveloped	Inholdings	Miles of wilderness boundary adjacent to inholdings.	Refuge biologist, maps	1	Initial data gathering took a quite some time, but it is expected that future gathering will not take as long since initial gathering is complete.
Undeveloped	Use of motorized or mechanical	Number of unauthorized motorized / mechanized uses.	Uniform Crime Report (UCR). Available from complex law enforcement staff	1	Meeting included inquiries about several measures. Would take minimal time inquiring about this in the future.

Undeveloped	Use of motorized or mechanical	Number of authorized motorized / mechanized uses.	Source for Wildlife Management Purposes: Refuge biologist, regional biologist. Source for emergency use purposes: Complex law enforcement staff and fire management team	1	Meeting included inquiries about several measures. Would take minimal time inquiring about this in the future. Compiled data into INWR File 40.50 "Wilderness Character Monitoring."
Undeveloped	Loss of cultural resources	Number of anthropogenic and/or wildlife-caused disturbances to cultural resources	Refuge biologist, Field	5	Inquiries to biologist, regional cultural resources representative, and local experts. Going to as many known cultural resource sites as possible and documenting damage. Compiled data into INWR File 40.50 "Wilderness Character Monitoring."
Solitude +	Remoteness from inside	Miles of trails and roads within wilderness	Refuge biologist, GIS maps		Initial data creation (GIS mapping) of wilderness roads took a quite some time, but it is expected that future gathering will not take as long since initial gathering is complete. Compiled data into INWR File 40.50 "Wilderness Character Monitoring."
Solitude +	Remoteness from outside	Number of man-made structures visible from wilderness	Refuge biologist	1	Meeting included inquiries about several measures. Would take minimal time inquiring about this in the future. Compiled data into INWR File 40.50 "Wilderness Character Monitoring."

Solitude +	Remoteness from outside	Incidents of machinery or mechanized equipment used for maintenance or structure removal adjacent to wilderness	Complex law enforcement staff	1	Meeting included inquiries about several measures. Would take minimal time inquiring about this in the future.
Solitude +	Facilities that decrease self-reliant recreation	Number of agency-provided recreation facilities	Refuge manager	1	Meeting included inquiries about several measures. Would take minimal time inquiring about this in the future.
Solitude +	Mgmt restrictions on visitor behavior	Number of acres where camping is not allowed.	Refuge manager	1	Meeting included inquiries about several measures. Would take minimal time inquiring about this in the future.
Solitude +	Mgmt restrictions on visitor behavior	Number of acres where campfires are not allowed	Refuge manager	1	Meeting included inquiries about several measures. Would take minimal time inquiring about this in the future.
Solitude +	Mgmt restrictions on visitor behavior	Number of acres where hunting is not allowed	Refuge manager	1	Initial data gathering took a quite some time, but it is expected that future gathering will not take as long since initial gathering is complete.

Refuge Staff Effort

Title of staff involved in identifying, prioritizing, and selecting measures	Staff time to identify, prioritize, and select measures (in whole hrs)	Comments
Refuge Biologist, Joseph Barnett	15	Developing measures, provided data, approval of database entries.
Fire Management Team, Benjamin Stewart	1	Provided data.
Refuge / Complex Manager, Elaine Johnson	10	Developing measures, reading emails related to WCM. Wants to add input on database entries/measures.
Regional / Complex Biologist, Brenda Zaun	5	Defining measures, provided data.
Complex Law Enforcement Staff, Drew Cyprian	1	Defining measures, provided data.
Visitor Services Manager, Denise Bausch	3	Orientation to refuge and wilderness issues, provided data sources.
Administration, John Meagher	2	Computer access, refuge file location.
All Staff	1	Wilderness Character Monitoring presentation to all refuge staff.

Wilderness Fellow Effort

Time you spent to identify, prioritize, and select all the measures (in whole hours)	Time you spent to learn how to enter data into the WCM database application (in whole hours)	Time you spent to enter all data into the WCM database application (in whole hours)	Time you spent on other tasks directly related to WCM (e.g., reading CCP, giving presentations, talking with staff) (in whole hours)	Time you spent doing <u>other</u> Refuge tasks not directly related to WCM (in whole hours)
100	5	40	165	300 (This includes: visits to the wilderness, helping with field work, logging SCA hours, etc.)

~ 30 hours Reading/Researching
~ 40 hours Meetings
~ 5 hours Presentations
~ 50 hours Finding/Gathering Data
~ 40 hours Final Report/Worksheets

Appendix C - Table: Detailed Description of Data Sources and How the Data Were Gathered

FWS National Wildlife Refuge System Wilderness Fellows

Keeping Track of Wilderness Character Monitoring Measures

Refuge: Imperial National Wildlife Refuge
Date: September, 2011
Prepared by: Molly McCarter

Measure	Priority (H, M, L)	Detailed Description of the Data Source(s) and How the Data Were Gathered
Untrammeled Quality		
1. Percent of naturally started fires that received a suppression response.	H	Inquiry to the fire operations specialist.
2. Number of burros that are captured and removed from wilderness (Burro "gathers").	M	Inquiry to the refuge biologist.
3. Number of actions to trammel species in wilderness (including actions for surveys or research).	H	Inquiries to the refuge biologist, zone biologist, and Arizona Game and Fish Department. Compiled data in Imperial NWR File 40.50 "Wilderness Character Monitoring."
4. Acres of wilderness burned due to human-caused wildfires.	H	Inquiry to the fire operations specialist.
Natural Quality		
5. Number of bat species present in wilderness	H	Inquiries to the refuge biologist, zone biologist, and Arizona Game and Fish Department. Compiled visual and acoustic detection data that occurred within the Imperial National Wildlife Refuge in the last 5 years.
6. Number of non indigenous species in wilderness.	H	Inquiries to the refuge biologist, zone biologist, and Arizona Game and Fish Department. Compiled data in Imperial NWR File 40.50 "Wilderness Character Monitoring."
7. Average percentage of vegetation utilized by burros in washes that include wilderness.	H	Zone biologist can provide data. Approximately 10 washes are selected for surveying annually. Refuge staff survey within the wash starting from a reference point near the Colorado River out to one mile. There are 100 points within this one mile. 100

		points within this mile are assessed for utilization, hedging and bark stripping on five key species of plants. This is a tool used to help refuge staff evaluate when burros numbers are too high based on their damage to the vegetation.
8. Number of extirpated indigenous plant and animal species.	H	Inquiries to the refuge biologist, zone biologist, and Arizona Game and Fish Department. Additional research into the historic range of the Sonoran pronghorn, which proved futile. Compiled data in Imperial NWR File 40.50 "Wilderness Character Monitoring."
9. Air Quality Data	H	This measure and data is to be entered by the I&M Program.
10. Percent of mines or other bat habitats in wilderness confirmed with white-nose syndrome.	H	Inquiry to the refuge biologist.
Undeveloped Quality		
11. Number of mines with bat gates or mine safety structures.	H	Inquiry to the refuge biologist. Mine locations with gates are mapped as a GIS layer.
12. Number of actions at separate locations to remove modern man-made debris in wilderness (including abandoned property, mine-era waste, and signs).	H	Inquiries to the refuge manager, refuge biologist, complex law enforcement staff.
13. Number of cabins, corrals, and other man-made structures within wilderness.	H	Inquiry to the refuge biologist. Visits to wilderness to document structures. Compiled data in Imperial NWR File 40.50 "Wilderness Character Monitoring."
14. Acres of inholdings within wilderness.	H	Using a GIS map and relevant layers, calculated the area of inholdings within the wilderness.
15. Miles of wilderness boundary adjacent to inholdings.	M	Using a GIS map and relevant layers, calculated the miles of wilderness boundary that is adjacent to inholdings.
16. Number of unauthorized motorized/mechanical uses.	H	Inquiry to complex law enforcement. Data is compiled annually (ending in December) in the Uniform Crime Reports.
18. Number of anthropogenic and/or wildlife-caused disturbances to cultural resources.	H	Inquiry to the refuge biologist, regional cultural resources representative, and local experts. Visited several known cultural sites and assessed damage. Compiled data in Imperial NWR File 40.50 "Wilderness Character Monitoring."

Solitude or Primitive and Unconfined Quality		
19. Miles of trails and roads within wilderness.	H	Inquired to staff about the presence of roads in wilderness to determine approximate locations. Viewed high definition aerial map of wilderness and topographic maps to located roads and determine whether or not they extended into the wilderness boundary. Created a "wilderness roads" GIS layer which maps the roads that are visible by on this aerial map. Calculated the miles of roads in wilderness. Compiled data in Imperial NWR File 40.50 "Wilderness Character Monitoring."
20. Number of man-made structures visible from wilderness.	H	Inquiry to the refuge biologist. Visits to wilderness to document structures. Compiled data in Imperial NWR File 40.50 "Wilderness Character Monitoring."
21. Number of authorized aerial uses over wilderness.	M	Inquiries to the zone biologist and complex law enforcement staff. Compiled data in Imperial NWR File 40.50 "Wilderness Character Monitoring."
22. Number of agency-provided recreation facilities.	H	Inquiry to the refuge manager. Reading refuge files.
23. Acres where camping is not allowed.	H	Inquiry to the refuge manager. Reading refuge files.
24. Acres where campfires are not allowed.	H	Inquiry to the refuge manager. Reading refuge files.
25. Acres where hunting is not allowed.	H	Used GIS map and relevant layers to calculate the area within the wilderness where hunting is prohibited.

Imperial National Wildlife Refuge, Molly McCarter (2011)